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## Bulletin No. 263 - Relative Produciton of Feed Grain from Spring-Grown Cereals in Utah

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# Relative Production of Feed Grain from Spring-Grown Cereals in Utah

R. W. WOODWARD and D. C. TINGEY

(In Cooperation with the Division of Cereal Crops and Diseases, Bureau of Plant  
Industry, United States Department of Agriculture)

UTAH AGRICULTURAL EXPERIMENT STATION  
UTAH STATE AGRICULTURAL COLLEGE

Logan, Utah

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# Relative Production of Feed Grain from Spring-Grown Cereals in Utah

R. W. WOODWARD and D. C. TINGEY<sup>2</sup>

## INTRODUCTION

Nearly one-third of the cropped acreage of Utah is devoted to cereals. Except for wheat, most of these crops are fed locally. In addition to this, an average of over a million bushels of corn, barley, and oats is shipped into the state each year to be used in various livestock and poultry industries (Table 1).

The total acreage of spring wheat, oats, barley, and corn for a 10-year period, from 1924 to 1933, inclusive, is shown in Table 2; Table 3 indicates the acreage of these same crops by counties for 1929.

Wheat, oats, and barley are adapted to similar soil and climatic conditions, whereas corn is more limited in its adaptation. Soil and climate would have a minor influence in the choice of a small-grain crop. If a cash crop is desired, one may prefer to grow wheat; if, however, the grain is intended for local farm consumption, then barley, oats, and corn may be used.

The purpose of this publication is to show the comparative amount of feed produced by the different crops<sup>3</sup>—wheat, oats, barley, and corn—under similar conditions as determined for the specified four years by acre-yields obtained in various agricultural regions of the state. One should bear clearly in mind that its purpose is not to encourage all farmers to grow crops giving the highest feed value to the acre or to shift from one cereal to another, although this might be done to advantage if increased feed production is desired.

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**Acknowledgment:** Appreciation is expressed to those who in any way have helped to make this investigation possible and a success from the standpoint of results obtained. This includes all substation superintendents, various county agricultural agents, local growers, and Station staff members. The seed of different varieties and strains of oats used as well as the history of these varieties and strains were furnished by the Division of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture.

<sup>1</sup>Contribution from Department of Agronomy, Utah Agricultural Experiment Station.

<sup>2</sup>Junior Agronomist, Division of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture, and Assistant Agronomist, Utah Agricultural Experiment Station, respectively.

<sup>3</sup>These comparisons are based on grain only. The straw of wheat and barley would be about equal in value, though the corn fodder would give a higher relative acre value. Consequently, the data presented here are not a fair comparison for corn. Corn is quite a different crop from the small grains from the standpoint of place in the cropping system, adaptation, and use. In Utah, corn is grown primarily as a silage crop. Because of these other conditions and their effects on the farm setup, no attempt has been made to compare corn with the small grains except insofar as the grain itself is concerned, and even this may be misleading since with a limited supply of water corn may be more productive than small grains.

Publication authorized by Director, 5 June 1935.



**Table 1—Approximate number of bushels of corn, barley, and oats shipped into Ogden Utah<sup>1</sup>**

Yield	Crop		
	Corn	Barley	Oats
1928-29 .....	660,000	100,500	208,500
1929-30 .....	655,500	289,500	172,500
1930-31 .....	1,017,000	496,500	148,000
1931-32 .....	705,000	136,500	94,500
1932-33 .....	400,500	124,500	76,500
1933-34 .....	519,000	196,500	129,000
Average			
Crop .....	659,500	224,000	138,250
Yearly Import	.....	.....	1,021,750

<sup>1</sup>Data supplied by L. W. Grady, Federal Grain Supervisor, Ogden, Utah. Grain shipped into the state, other than through Ogden, is not included; shipments may have been rediverted to regions outside of the state. Data on how much was diverted were not available.

## METHODS AND MATERIALS

Data consist of comparative yield tests of leading varieties of each of the following cereals: wheat, barley, oats, and corn. Cooperative farmers or substation superintendents cared for the tests during the growing season. Federation and Dicklow wheats, Trebi barley, Swedish Select oats, and Minnesota No. 13 corn were grown during the four years the test was run. Since these are the leading varieties grown by farmers, they were used for making comparisons. While the terms barley, oats, wheat, and corn are used throughout this discussion, specific reference is to results obtained from varieties named.

Corn was not included in all tests; therefore, a comparison of the acre-yields was made only for those counties in which all cereals under consideration were grown on the same field. In counties where corn was not included, barley, oats, and spring wheat are offered for comparison, the comparisons being made on the basis of (1) acre-yields in bushels, (2) pounds per acre, (3) total digestible nutrient, and (4) relative feed value.

From the number of pounds produced per acre, total digestible nutrients were calculated and the relative or "actual" feeding value determined. Total digestible nutrients were based on average analysis as given in "Feeds and Feeding" by Henry and Morrison<sup>4</sup>.

Factors for relative feed value as used in this publication were obtained through the Bureau of Animal Husbandry, United States Department of Agriculture. Obviously, it is difficult to make "hard and fast" comparisons of one cereal with another either by their total digestible nutrients or from actual feeding tests. When asked for a general statement on the relative feed value of cereals, however, the following statement was made by A. T. Semple of the Bureau: "In general, our policy, based on feeding experiments, has been to rank wheat and corn as equal in feeding value. On that basis, we have valued barley at 95 and oats at 85. It is practically impossible to make hard and fast comparisons, since so much depends upon the class of livestock, the other feeds in the ration and the purpose of the feeding, whether for maintenance, fattening, or milk production. While the information I have just given you is rather inconclusive and leaves you to draw your own conclusions

<sup>4</sup>Henry, W. A. and Morrison, F. B. "Feeds and Feeding": 709-743 (1923) (18th ed., unabridged).

as to which figures should be used, in the case you have in mind, I should recommend 100 for wheat and corn, 95 for barley, and 85 for oats."<sup>5</sup>

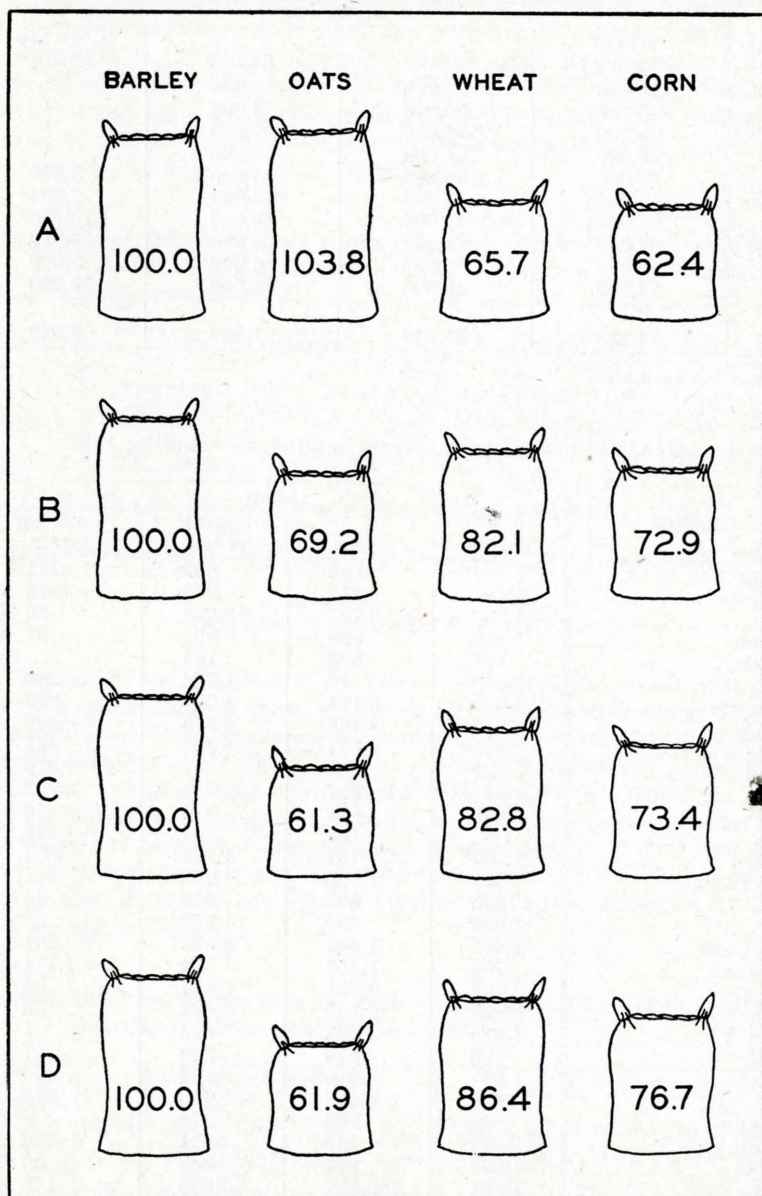


Figure 1.—Relative production of barley, oats, wheat, and corn. A=bushels per acre; B=pounds per acre; C=total digestible nutrients; and D=relative feed as shown by actual feeding tests.

<sup>5</sup>Through correspondence, E. J. Maynard, Utah Station Animal Husbandman, contacted fifteen animal husbandmen in the intermountain states concerning the relative feed value of the different cereals. Figures obtained averaged approximately the same as those given by A. T. Semple of the Federal Bureau of Animal Husbandry.



Table 2—Acreage of cereals in Utah, 1924 to 1933, inclusive

Year	Crop			
	Wheat (Spring)	Oats	Barley	Corn for Grain
1924 ....	105,000	55,000	14,000	1
1925 ....	88,000	60,000	18,000	1
1926 ....	88,000	54,000	20,000	1
1927 ....	90,000	51,000	30,000	1
1928 ....	95,000	55,000	34,000	9,000
1929 ....	80,380	45,480	38,069	7,294
1930 ....	82,000	46,000	42,000	10,000
1931 ....	63,000	43,000	38,000	7,000
1932 ....	76,000	54,000	44,000	8,000
1933 ....	74,000	50,000	37,000	10,000
Avg. ....	84,138	51,348	31,507	8,549

<sup>1</sup>Data not available.

Table 3—Acreage of spring-sown cereals in Utah, by counties, 1929

County	Crop			
	Barley	Oats	Spring Wheat	Corn for Grain
Beaver .....	443	596	665	111
Boxelder .....	5,197	2,216	9,079	112
Cache .....	4,399	2,791	10,548	20
Carbon .....	180	828	804	57
Daggett .....	178	596	184	.....
Davis .....	1,309	410	1,754	63
Duchesne .....	1,050	3,171	4,097	382
Emery .....	617	4,136	4,576	390
Garfield .....	860	1,677	559	231
Grand .....	20	55	.....	1,036
Iron .....	361	687	459	732
Juab .....	640	615	333	26
Kane .....	.....	155	47	416
Millard .....	1,497	761	1,239	362
Morgan .....	958	599	1,226	.....
Piute .....	395	625	915	44
Rich .....	1,004	890	1,222	.....
Salt Lake .....	1,632	1,689	6,993	201
San Juan .....	704	1,350	94	1,174
Sanpete .....	2,797	5,751	7,817	52
Sevier .....	2,888	2,245	4,682	33
Summit .....	1,084	1,452	674	1
Tooele .....	780	578	549	47
Uintah .....	1,047	2,679	2,982	499
Utah .....	3,600	4,438	11,709	673
Wasatch .....	805	924	1,274	.....
Washington .....	613	145	351	436
Wayne .....	1,080	924	983	56
Weber .....	1,931	2,587	4,565	140
Total .....	38,069	45,480	80,380	7,294

## YIELDS IN BUSHEL PER ACRE

Yields of cereals are usually measured in terms of bushels per acre, and on this basis the comparative yields for wheat, oats, barley, and corn are shown (Table 4). It will be observed that oats, when measured on this basis, produced the highest average yield, with barley a close second. Wheat and corn are about equal and produce a little over one-half as many bushels per acre as do oats and barley. When barley is taken as 100, then oats, wheat, and corn are 104, 59.2, and 58.3, respectively.

Table 4—Acre and percentage yields (bushels) of wheat, corn, barley, and oats for each of four years in counties where all crops were grown on the same field

Crop	Acre-yield (bushels)					Percentage Yields (bushels)				
	1931	1932	1933	1934	4-year Avg.	1931	1932	1933	1934	4-year Avg.
Barley ....	83.4	76.9	95.1	106.7	90.5	100.0	100.0	100.0	100.0	100.0
Wheat ....	55.0	58.2	61.4	63.2	59.5	66.0	75.7	64.6	59.2	65.7
Corn .....	54.6	51.2	58.1	62.2	56.5	65.5	66.6	61.1	58.3	62.4
Oats .....	92.4	83.0	89.2	111.0	93.9	110.8	107.9	93.8	104.0	103.8

## YIELDS IN POUNDS PER ACRE

Because of the difference in the number of pounds per measured bushel, this basis of comparing relative production of cereals is misleading; a fairer basis would seem to be one based on pounds per acre. On this basis, as shown in Table 5, barley excels wheat, corn, and oats by 18, 24, and 31 per cent, respectively. Although oats produced the highest yield in bushels per acre, they are lowest when measured on the basis of pounds per acre. The fact that wheat and corn are considered more valuable per pound as a feed than either oats or barley suggests that possibly some other basis of comparison, such as total digestible nutrients or relative feed value, would be a better basis for comparison.

Table 5—Total pounds per acre for each crop as obtained from county tests and relative percentage (Barley=100)

Variety	Total Pounds per Acre					Percentage				
	1931	1932	1933	1934	4-year Avg.	1931	1932	1933	1934	4-year Avg.
Barley ....	4,003	3,691	4,565	5,122	4,345	100.0	100.0	100.0	100.0	100.0
Wheat ....	3,300	3,492	3,684	3,792	3,567	82.4	94.6	80.7	74.0	82.1
Corn .....	3,058	2,867	3,254	3,483	3,166	76.4	77.7	71.3	68.0	72.9
Oats .....	2,957	2,656	2,854	3,552	3,005	73.9	72.0	62.5	69.3	69.2



### TOTAL DIGESTIBLE NUTRIENTS PER ACRE

Based on the total digestible nutrients per pound (Table 6) for various cereals and from the pounds produced per acre (Table 5), it was possible to calculate the total digestible nutrients produced per acre (Table 7).

Table 6—Pounds of total digestible nutrients in 100 pounds of grain<sup>1</sup>

Cereals	Percentage Total Digestible Nutrients
Barley .....	79.4
Oats .....	70.4
Wheat .....	80.1
Corn .....	80.0

<sup>1</sup>"Feeds and Feeding" by Henry and Morrison. (See Footnote 4, page 4)

It will be noted from Table 7 that the percentage of total digestible nutrients for the different cereals does not materially change the relationship of barley, wheat, and corn as compared on the basis of pounds per acre (Table 5) but that it does lower the relative value of oats. On the basis of yield in total digestible nutrients, with barley equal to 100, it excels wheat by 17 per cent, corn by 26 per cent, and oats by 38 per cent.

Table 7—Total digestible nutrients (pounds per acre) and percentage for each crop grown in the same fields in several Utah counties

Variety	Total Digestible Nutrients (lbs.) per Acre					Percentage for Each Crop				
	Year				4-year Avg.	Year				4-year Avg.
	1931	1932	1933	1934		1931	1932	1933	1934	
Barley ....	3,178	2,931	3,625	4,067	3,450	100.0	100.0	100.0	100.0	100.0
Wheat ....	2,643	2,797	2,951	3,037	2,857	83.2	95.4	81.4	74.7	82.8
Corn .....	2,446	2,294	2,603	2,786	2,532	77.0	78.3	71.8	68.5	73.4
Oats .....	2,082	1,870	2,009	2,501	2,116	65.5	65.8	55.4	61.5	61.3

It has been pointed out by Semple that a comparison on digestible nutrients alone is not wholly satisfactory, principally on account of the differences in physical qualities of feeds and the amounts of energy required to digest them.

### RELATIVE FEED VALUE PER ACRE

The term "actual feeding value" is used to designate the relative feed value of crops, as shown by numerous feeding tests in which cereals have been compared. An average value for cereals for all feeding purposes has been obtained, as previously discussed, and on this basis the relative productivity of different cereals was compared.

In actual feeding tests, wheat and corn were considered equal and were given relative values of 100. Barley and oats were valued at 95 and 85,

respectively, when compared to wheat and corn on the basis of equal weights. These relative values were used to convert pounds per acre for the respective cereals into relative feed value. Results of these calculations are shown in Table 8. Barley, taken as 100, exceeds wheat, corn, and oats by 13, 23, and 38 per cent, respectively.

Table 8—Relative feed values in pounds per acre and percentage for each crop grown on the same fields in various Utah counties (Barley = 100)

Variety	Pounds per Acre					Percentage				
	Year				Avg.	Year				Avg.
	1931	1932	1933	1934		1931	1932	1933	1934	
Barley ....	3,803	3,506	4,337	4,866	4,128	100.0	100.0	100.0	100.0	100.0
Wheat ....	3,300	3,492	3,684	3,792	3,567	86.8	99.6	84.9	77.9	86.4
Corn .....	3,058	2,867	3,254	3,483	3,166	80.4	81.8	75.0	71.6	76.7
Oats .....	2,513	2,258	2,426	3,019	2,554	66.1	64.4	55.9	62.0	61.9

Results by individual years are consistent and in close agreement with averages for the entire test. When comparison in percentages is made for actual feed value, wheat and corn more nearly approach barley than is shown by comparisons on the basis of total digestible nutrients or total yield in pounds per acre. The relative position of oats in relation to barley is only slightly changed where actual feeding values are used in place of total digestible nutrients (Tables 7 and 8).

### A SUMMARY OF ALL COMPARISONS ON AN ACRE BASIS

Table 9 gives a summary of the comparative productivity of different cereals on an acre basis. It will be noted that the relative acre production of the various crops remains about the same, whether compared on basis of pounds, total digestible nutrients, or relative feed value.

Table 9—Summary of comparative productivity of different cereals on an acre basis

Crop	Acre Production				Relative Percentage			
	Bushels	Pounds	T.D.N. <sup>1</sup>	Relative Feed Value	Bushels	Pounds	T.D.N. <sup>1</sup>	Relative Feed Value
Barley .....	90.5	4,345	3,450	4,128	100.0	100.0	100.0	100.0
Wheat .....	59.5	3,567	2,857	3,567	64.7	82.8	82.8	86.4
Corn .....	56.5	3,166	2,532	3,166	62.4	72.9	73.4	76.7
Oats .....	93.9	3,005	2,116	2,554	103.8	69.2	61.3	61.9

<sup>1</sup>T. D. N.—Total digestible nutrients.



## ACRE PRODUCTION OF DIFFERENT CEREALS BASED ON RELATIVE FEED VALUE BY COUNTIES

In discussing county averages where comparative data were available, a comparison was made on an acre basis between (1) yields in bushels, (2) yields in pounds, (3) total digestible nutrients, and (4) relative feed value. It was shown that the last three comparisons gave quite similar results. In comparing the relative productivity of the different cereals by counties, only the last method, that based on the relative feed value, will be made, since this would seem to be the fairest basis of comparison.

Data based on the relative feed value per acre for each county are shown in Table 10. Data for each year is shown separately, and considerable variation from season to season within a county is obvious. This is due largely to variation in soil conditions. Even though the various crops were grown in the same field side by side, each was grown in a block by itself. Timeliness of irrigation also influences production. Variation is probably not greater than would be obtained from similar data taken from a group of farms.

It is interesting to observe from Table 10 that in not a single county did oats equal barley in relative production of feed per acre. In comparison with barley at 100, the relative productivity of oats ranged from as low as 34 per cent in Iron County to 82 per cent in Cache County. Wheat exceeded barley in only one county (Cache). Corn exceeded barley in three counties (Utah, Carbon, and San Juan); Carbon is the only one of these three counties in which tests were run for more than one year where corn exceeded barley. As previously stated, grain only is used in these comparisons. If corn fodder were considered from the standpoint of its real value, as compared with the straw from the small grains, corn would rank much higher. Even based on grain alone, corn may be more productive of feed than barley where the water-supply is limited, as was true in the three counties where corn exceeded barley.

In Table 10 (Column 6) is shown the relative 1929 acreage of oats and barley in the counties where tests were conducted. Carbon, Garfield, Iron, Salt Lake, San Juan, Utah, Uintah, and Sanpete Counties produced a larger acreage of oats than of barley. Yet in these same areas, barley produced from 25 to 66 per cent more feed per acre than oats.

**Table 10—Comparative acre production of different cereals based on relative feed value and relative acreage of barley and oats (Barley=100)**

County	Crop			Relative Acreage 1929 of Barley and Oats (Barley = 100)
	Oats	Wheat	Corn	
<b>CACHE:</b>				
1931	81	92	81	
1932	97	153	108	
1933	74	85	106	
1934	84	103	64	
Average .....	82	108	90	63
<b>UINTAH:</b>				
1931	60	74	....	
1932	75	87	78	
1933	55	99	31	
1934	54	75	57	
Average .....	61	84	56	256



County	Crop			Relative Acreage 1929 of Barley and Oats (Barley = 100)
	Oats	Wheat	Corn	
<b>BOXELDER:</b>				
1931	78	96	73	
1933	68	49	112	
1934	71	46	100	
Average .....	72	74	95	43
<b>UTAH:</b>				
1931	71	69	....	
1932	81	98	162	
1933	68	....	....	
Average .....	73	83	....	123
<b>CARBON:</b>				
1931	63	71	141	
1932	56	85	96	
1933	59	77	102	
Average .....	59	78	113	460
<b>SANPETE:</b>				
1931	40	....	34	
1932	59	99	....	
1933	49	95	52	
Average .....	49	97	43	206
<b>MILLARD:</b>				
1931	20	....	54	
1932	52	74	19	
1933	61	93	59	
Average .....	44	83	66	51
<b>IRON:</b>				
1932	39	....	54	
1933	32	70	70	
Average .....	34	....	62	190
<b>SALT LAKE:</b>				
1931	75	90	....	
1932	67	83	....	
1933	68	96	....	
1934	90	107	....	
Average .....	75	94	....	103
<b>WASHINGTON:</b>				
1932	43	....	....	
1933	66	58	....	
Average .....	54	....	....	24
<b>GARFIELD:</b>				
1932	43	77	....	
1933	51	116	....	
Average .....	47	96	....	195
<b>SEVIER:</b>				
1931	41	86	....	78
<b>DAVIS:</b>				
1931	55	61	....	31
<b>SAN JUAN:</b>				
1932	75	98	132	192
<b>AVG. FOR STATE</b>				119

## DISCUSSION AND SUMMARY

Leading varieties of barley, wheat, oats, and corn have been grown on the same fields in a number of counties of the state for the four years 1931, 1932, 1933, and 1934. Grain yields obtained from these tests were used as a basis in comparing the relative acre production of feed produced by the different cereals. Comparisons were made on an acre basis, as follows: (1) bushels, (2) pounds, (3) total digestible nutrients, and (4) relative feed value:

- (1) Oats excel all other cereals in bushels per acre, with barley a close second.
- (2) On the basis of pounds per acre, barley exceeds wheat, corn, and oats by 18, 27, and 31 per cent, respectively.
- (3) On the basis of total digestible nutrients, barley exceeds wheat, corn, and oats by 17, 26, and 38 per cent, respectively.
- (4) Based on relative feed value, barley exceeds wheat, corn, and oats by 13, 23, and 38 per cent, respectively.

Data by individual counties show considerable variation when cereals are compared on the basis of relative feed produced. Wheat and corn occasionally produced more than barley, but in no instance did oats exceed barley. The production average for barley for the years tested was from 18 to 66 per cent more per acre than for oats. The United States Census Report for 1930, however, shows that 18 of Utah's 29 counties produced a larger acreage of oats than of barley.